PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In the **PATENT APPLICATION** of: Miles et al.	Our File: SHP-PT077
Application No.: 10/612,133	
Confirmation No.: 3323	
Filed: July 2, 2003	
For: RESONANT SCANNING PROBE MICROSCOPE	
Group: 2878	
Examiner: Thanh X. Luu	

DECLARATION OF ANDREW DAVID LAVER HUMPHRIS PURSUANT TO 37 C.F.R. § 1.132

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

I, Andrew David Laver Humphris, declare that:

1. I am a named inventor of the subject matter described and claimed in the above-identified patent application.

2. I have been working in the field of microscopy, and in particular scanning probe microscopy and related techniques, for approximately 9 years.

3. I received a Master in Science degree in Physics in 1997 from the University of Bristol, UK. I received a PhD in Physics in 2001 from the University of Bristol, UK.

4. I have attained the following certifications, accomplishments and achievements in the field of scanning probe microscopy:

YEAR	DESCRIPTION
1997 – Present	Published and coauthored over 30 papers and book chapters.
1998 – Present	Invited speaker at national and international conferences.
2001	PhD, University of Bristol, UK
2003	Proleptic lectureship in Physics, University of Bristol, UK.

5. I have held the following positions:

YEAR	DESCRIPTION
2001 – 2002	Post doctoral researcher at the University of Bristol, UK. Duties included research in the area of scanning probe microscopy.
2002 – 2004	Research Fellow of the Royal Commission for the Exhibition of 1851. Duties included research in the area scanning probe microscopy.
2004 – Present	Chief Technology Officer of Infinitesima Ltd., Oxford, UK. Duties include overseeing technology aspects for the company which strongly focuses on scanning probe microscopy and related techniques.

6. I am a named inventor on several patents and published applications, including:

PAT. NO.	TITLE
US6906450	Resonant Probe Driving Arrangement and a Scanning Probe Microscope Including such an Arrangement (corresponding applications include Australia, Canada, Europe, Japan)

US2003/160170	Methods and Apparatus for Atomic Force Microscopy
2004/0051542	Scanning Probe Microscope
US2004/0232321	High Speed SPM (corresponding applications include Europe, Japan)
EP1644937	Probe for an Atomic Force Microscope (corresponding applications include China, South Korea, Russian Federation, United States of America)

7. In view of my education and experience, I believe myself to be a person of at least ordinary skill in this art.

8. I have reviewed the August 31, 2006 Office Action and U.S. Patent Nos. 5,254,854 (Betzig et al.), 6,752,008 (Kley), 6,008,489 (Elings), and 6,614,227 (Ookubo), which were cited alone or in combination to reject claims 1-19, 21, and 23 of the present application.

9. The following rejections were cited in the Office Action: (1) claims 21 and 23 were rejected under 35 U.S.C. § 102(b) as being anticipated by Betzig; (2) claims 1, 3, and 12-18 were rejected under 35 U.S.C. § 103(a) as being obvious over Betzig in view of Elings; (3) claims 1-4, 6-19, and 21 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Kley in view of Betzig and Elings; and (4) claim 5 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Kley in view of Betzig and Elings and further in view of Ookubo.

10. Independent claim 1 of the present invention recites, in pertinent part:

> the microscope (10, 50) is arranged, in operation, to carry out a scan of the sample surface wherein a scan area is covered by an arrangement of scan lines, each scan line involving a plurality of readings and being provided by laterally oscillating either the probe (20, 54) or the sample (12) at or near its resonant frequency such that oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the driving means (16, 22).

11. Independent claim 21 of the present invention recites, in pertinent part:

> Laterally oscillating either the probe (20, 54) across the surface of the sample (12) at or near its resonant frequency or the sample (12) beneath the probe (20, 54) at or near its resonant frequency to provide a relative oscillatory motion between the probe (20, 54) and surface such that an arrangement of scan lines, whose maximum length is directly determined by oscillation amplitude, covers the scan area, each scan line comprising a plurality of readings;

12. Similarly, independent claim 23 of the present invention recites, in pertinent part:

> the microscope (10, 50) is arranged, in operation, to carry out a scan of the sample surface wherein a scan area is covered by an arrangement of scan lines, each scan line involving a plurality of readings and being provided by laterally oscillating either the probe (20, 54) or the sample (12) at or near its resonant frequency such that oscillation amplitude directly determines maximum scan line length and the arrangement of scan lines is provided by operation of the driving means (16, 22).

13. As one of ordinary skill in this art, I can attest that the term "scan line" is understood in the field of microscopy to refer to a collection of separate readings taken along a line which are used to build up an image of the sample.

14. In support of this interpretation, attached as Exhibit "A" is a copy of the cover page, introductory pages ii-vi, and pages 59-61 from the Nanoscope User Guide from Veeco Instruments, which uses the term "scan line" in accordance with its well recognized meaning in the field of microscopy. In particular, on pg. 61 under the heading "samples/line," the User Manual references selecting "the number of sample data points per scan line," with the range being 128 to 16384 sample points per line. The meaning of this term is further exemplified in the User Manual stating "samples/line should be kept at 512 or higher for high resolution scans." See Exhibit A at pg. 61.

15. As Veeco Instruments has a majority of market share in total atomic force microscopy (AFM) sales, the use of the term "scan line" in this manual is exemplary of the well accepted meaning in this industry.

16. Further evidence of the well accepted meaning of the term "scan line" may be found at column 4, lines 3-18 of U.S. Patent No. 6,752,008 (Kley).

17. Thus, the term "scan line" as used in independent claims 1, 21 and 23 of the present invention should be interpreted in view of its well accepted meaning in the field of microscopy as a laterally extending line along which a plurality of separate readings are taken.

18. Independent claims 1, 21, and 23 further require that each scan line must be provided by oscillating either the probe or sample at or near resonant

frequency and that the maximum length of the scan line is determined by oscillation amplitude.

19. In Betzig, the probe is resonantly oscillated about each reading or measurement position and the amplitude of the resonant oscillation corresponds to that measurement alone, which, in turn, corresponds to a single pixel in the image of the surface that is produced. Once the measurement has been recorded, the probe in Betzig is moved/translated in a line to a new position where a new reading, for an adjacent pixel, would be taken by oscillating the probe about the new measurement position. This pattern of individual measurements is then repeated at new positions along the line until the readings for a complete scan line are recorded. It is possible for the average position about which the probe is being resonantly oscillated to be moved/translated continuously and the individual measurements recorded as the probe moves/translates along the line.

20. A person of ordinary skill in the field of microscopy would understand the lines 170 illustrated in Fig. 8 of Betzig would be "scan lines."

21. The "scan lines" in Betzig are not provided by means of resonant oscillation of the probe, but are determined with respect to the number of measurements to be taken and translation of the probe along the scan line 170.

22. The amplitude of the resonant probe oscillation in Betzig relates only to the +/- divergence from the precise measurement position for each individual

measurement position. Thus, the amplitude of the probe oscillation in Betzig would not be understood by a person of ordinary skill in the field of microscopy as corresponding to the length of a scan line as recited in independent claims 1, 21, and 23.

23. Elings does not suggest or disclose that each scan line has a plurality of readings and is provided by means of a resonant oscillation and that each scan line has a maximum length determined by oscillation amplitude as recited in independent claim 1.

24. The vertical oscillations in Elings are carried out to take a single measurement, and once that measurement has been recorded, the probe in Elings is moved/translated by the X-Y and Z translation stages to a new position where a new reading would be taken by vertically oscillating the probe about the new measurement position. Thus, there is no teaching or suggestion in Elings of a scan line having a plurality of readings and provided by means of a resonant oscillation.

25. Furthermore, the amplitude of the vertical oscillations in Elings would not determine a maximum "scan line" length as recited in claim 1 of the present invention.

26. I have been warned that willful false statements and the like are punishable by fine or imprisonment, or both (18 U.S.C. § 1001) and may jeopardize the validity of the application or any patent issuing thereon.

Applicant: Miles et al.
Application No.: 10/612,133

27. I declare under penalty of perjury under the law of the Unites States of America that the foregoing is true and correct.

Executed this 30th day of January 2007 at Infinitesima Ltd., Oxford, UK.

Andrew Humphris.

Dr. Andrew D.L. Humphris

Veeco

NanoScope Software 6.13 User Guide

Part Numbers
004-132-000 (Standard)
004-132-100 (Cleanroom)

Document Revision History: NanoScope Software 6.13 User Guide

Revision	Date	Section(s) Affected	Ref. DCR	Approval
D	12/23/2004	All		V. Kelley
C	06/23/2004	All	-	C. Kowalski
B	07/10/2003	All	404	T. Geschwender C. Kowalski
A	04/20/2002	Release	404	T. Geschwender

Product Names:
NanoScope®
MultiMode™
Dimension™
BioScope™
Atomic Force Profiler™ (AFP™)
Dektak®

Software Modes:
TappingMode™
Tapping™
TappingMode+™
LiftMode™
AutoTune™
TurboScan™
Fast HSG™
PhaseImaging™
DekMap 2™
HyperScan™
StepFinder™
SoftScan™

Hardware Designs:
TrakScan™
StiffStage™

Hardware Options:
TipX®
Signal Access Module™ and SAM™
Extender™
TipView™
Interleave™
LookAhead™
Quadrex™

Software Options:
NanoScript™
Navigator™
FeatureFind™

Miscellaneous:
NanoProbe®

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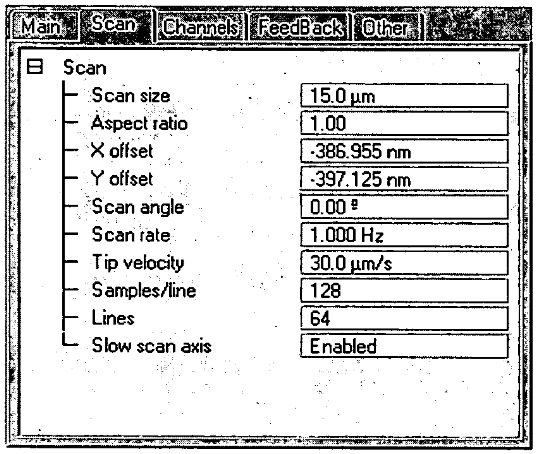
3.2.9 Scan Tab Interface

The **Scan** tab (see Figure 3.2r) includes parameters influencing piezo movement and data acquisition, as well as the ability to execute non-square scans. This **Tab** panel is probably the most frequently used panel, as it controls what type of scan to run, how large the scan is, its angle, scan rate, and number of samples per scan line.

Figure 3.2r Scan Tab Parameters



Scan Tab Parameters

Scan size Determines the size of the scan by controlling the voltage applied to the X and Y piezos.

Range or Settings:

- **0** to **440V**
- **0** to **XXµm** (scanner-dependent)

The units of this parameter are volts if the **Units** parameter (**Other Controls** panel) is set to **Volts**. The units are linear distance (nm or μm) if the **Units** parameter is set to **Metric**.

See also, Optimizing the Scan Size Parameter on page 85.

Aspect ratio Controls the width-to-height size ratio of scans. Set **Aspect ratio** to 1.00 for square scans. An **Aspect ratio** of 2.00 yields scanned images having width equal to twice the height.

Range or Settings: (depends upon the number of scan lines) **1** to **256**.

Figure 3.2s Aspect Ratio Example

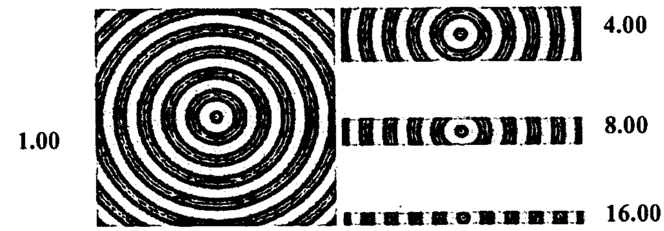
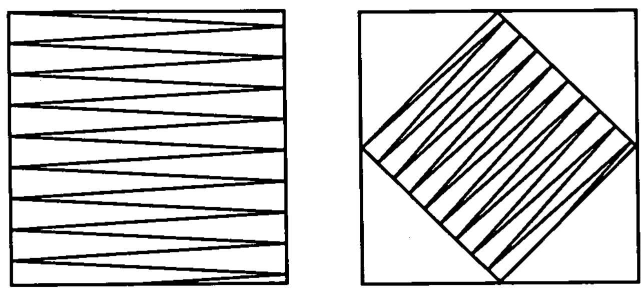


Figure 3.2t Scan Angle Rotated Example.



X offset, Y offset

Controls the center position of the scan in the X and Y directions, respectively.

Range or Settings: **±220V**; **± XXμm** (dependent on **Scan size** and scanner).

See also, Optimizing the X Offset, Y Offset Parameter on page 85.

Scan angle

Controls the angle of the X (fast) scan relative to the sample.

Range or Settings: **0** to **359°** (Any angular value can be entered with the keyboard)

Changing this parameter can dramatically affect the quality of images due to tip effects (tip side wall angle).

Setting this parameter to a setting besides 0 or 90° may reduce the maximum allowable **Scan size** 10-20 percent due to corner constraints (see Figure 3.2t).

Scan rate

The **Scan rate** sets the number of fast scan lines performed per second. When the Scan rates are low, it can take a fairly long time to scan an entire frame. For example, With the **Scan rate** set to **0.5Hz** and the **Number of samples** set to **512**, it can take over 17 minutes to capture a single image.

Range or Settings: **0.1-237Hz**, depending on the number of **Samples/line**.

See also, Optimizing the Scan Size and Scan Rate Parameters on page 85.

Lines

Selects the number of lines to scan in a frame. The **Lines** parameter reduces resolution along the Y axis. It also speeds imaging (or frame rate) and reduces the size of the resulting image file.

Range or Settings: **2** to **1024**. The maximum number of lines may be limited by the value for **Samples/line**.

Tip velocity

Velocity of the tip (in µm/s) as it scans over the surface.

When **Tip Velocity** is changed, the **Scan Rate** adjusts automatically.

Samples/line

Selects the number of sample data points per scan line.

When this parameter is changes, the number of scan lines per image (**Lines**) are automatically adjusted to maintain the same ratio between the samples/line and lines per image.

Range or Settings: **128** to **16384**. This setting influences the memory size of captured files and image resolution (see Table 3.2a).

Table 3.2a File Size/Samples per line

Samples/line value	**File size (for square scans, including 8K header)**
128	40Kb
256	136Kb
512	520Kb

Note: **Samples/line** should be kept at 512 or higher for high resolution scans. To increase the frame rate (rate at which complete images are generated), the **Lines** parameter should be reduced. When the **Lines** parameter is reduced, file sizes in Table 3.2a are reduced accordingly.

Slow scan axis

Allows the slow scan to be disabled, causing the fast scan to be repeated continuously at the same position. This means that the image displays the same line continuously. Images may be presented either as "true" X-Y renderings of the sample surface (Enabled), or as "stretched" single-line scans of length equal to the **Scan size** (Disabled).

Range or Settings:

- **Enabled**—Sample is scanned in the slow scan direction. (This is the normal setting of this parameter.)
- **Disabled**—No scanning of the sample in the slow direction is performed. The fast scan is repeated at the same position.

Note: Disabling the **Slow scan axis** and viewing the **Scope Mode** display is a convenient way of setting the **Feedback Gain** parameters.